

A Spectral Reflectance Model for Grain Size and Surface Liquid Water Mass Fraction in Melting Snow from 400 to 2500 nm

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A spectral, discrete ordinate, radiative transfer, snow reflectance model has been designed and implemented that accounts for the effects of grain size and liquid water fraction. The model is based in the spectral complex refractive index of liquid water and ice in the region from 400 to 2500 nm. Mie scattering calculations are used to specify the bulk optical properties for the snow. Two primary approaches are included the effect of liquid water in the snow implemented. The first approach accounts for the liquid water as a coating on an ice grain in the snow layer. The second approach accounts for the liquid water as separate spheres in the snow layer. Spectra from this model have been calculated for a wide range of illumination, observation and snow property conditions. A sensitivity analysis of these spectra shows the shape of modeled snow spectra to be sensitive to both the grain size as well as the presence and amount of liquid water in the snow. The modeled snow spectra are shown to be different in the two approaches to include the effect of water. The model approach that accounts for liquid water as interspersed sphere shows better agreement in an initial comparison with measured snow spectra. These results support the use of spectral models and special measurements to determine snow grain size and surface liquid water fraction from the remote sensing perspective in the solar reflected spectrum.